AIR POLLUTION CONTROL DISTRICT
COUNTY OF SAN LUIS OBISPO

2010
Ambient Air Monitoring Network Assessment

Monitoring and Compliance Division
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GLOSSARY AND LIST OF ACRONYMS:

Air Basin	An area with geographical or climatic conditions that result in a relatively physically homogeneous air mass.
APCD	Air Pollution Control District
ARB	California Air Resources Board
BAM	Beta Attenuation Monitor for particulate sampling
District	San Luis Obispo County Air Pollution Control District
EPA	U.S. Environmental Protection Agency
FRM	Federal Reference Method particulate sampler
NAAMS	National Ambient Air Monitoring Strategy
NAAQS	National Ambient Air Quality Standard
NO2	Nitrogen Dioxide
NOX	Oxides of nitrogen
O3	Ozone
ODSVRA	Oceano Dunes State Vehicular Recreation Area
Partisol	Federal reference method sampler for PM2.5.
PM10	Particulate matter 10 microns or less in aerodynamic circumference
PM2.5	Particulate matter 2.5 microns or less in aerodynamic circumference
SLAMS	State and Local Air Monitoring Stations
SLOAPCD	San Luis Obispo County Air Pollution Control District
SO2	Sulfur dioxide
TEOM	Tapered Element Oscillating Microbalance particulate sampler

1.0 INTRODUCTION

The San Luis Obispo County Air Pollution Control District (SLOAPCD) 2010 Ambient Air Monitoring Network Assessment is an examination and assessment of the technical aspects of SLOAPCD's network of air pollution monitoring stations.

The EPA finalized an amendment to the ambient air monitoring regulations on October 17, 2006. As part of this amendment, the EPA added the following requirement for state and local monitoring agencies to conduct a network assessment once every five years [40 CFR 58.10(e)]. The purpose is to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR 58.10 appendix D, if new sites are needed, if existing sites may be discontinued, and whether new technologies are appropriate for incorporation into the ambient air monitoring network.

This requirement is and outcome of implementation of the National Ambient Air Monitoring Strategy (NAAMS). The purpose of the NAAMS is to optimize U. S. air monitoring networks to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare.

2.0 SAN LUIS OBISPO COUNTY REGIONAL DESCRIPTION

2.1 Geography

San Luis Obispo County constitutes a land area of approximately 3,316 square miles with varied vegetation, topography and climate which creates a diversity of environmental conditions greater than its size would suggest. The county is bordered by Monterey County to the north, Santa Barbara County to the south, and Kern County to the east, with the Pacific Ocean as the western border. From a geographical and meteorological standpoint, the county can be divided into three general regions: the Coastal Plateau, the Upper Salinas River Valley, and the East County Plain. Air quality in each of these regions is characteristically different, although the physical features which divide them provide only limited barriers to transport of pollutants between regions.

The coastal plateau is about five to ten miles wide and varies in elevation from sea level to about 500 feet. It is bounded on the northeast by the Santa Lucia Mountain Range, which extends almost the entire length of the county. Rising sharply to about 3,000 feet at its northern boundary, the Santa Lucia Range gradually winds southward away from the coast, finally merging into a mass of rugged features on the north side of Cuyama Canyon.

The Upper Salinas River Valley historically has experienced the highest ozone levels in the county. Transport of ozone precursors from the coastal plateau and from the San Joaquin Valley may contribute to this condition. This area of plains and low rolling hills is bounded on the west by the Santa Lucia Range and to the east by the Cholame Hills, a northern extension of the Temblor Range. Southward, the La Panza Range gradually rises east of Santa Margarita and runs roughly parallel to the coast, merging with the Caliente Range near the southern border of the county. Caliente Mountain, the highest peak in the county at 5,104 feet, is found in this range.

The East County Plain is a large region by land area, but only one percent of the county population resides there. Dryland farming and unpaved roads in this region contribute to county totals for particulate emissions, but, due to the prevailing winds, these emissions rarely affect other regions of the county.

A significant portion of this area is a landlocked drainage basin called the Carrizo Plain, which lies between the La Panza and Caliente Ranges on the west and the Temblor Range to the east. These mountains join together to close the basin at the southeastern tip of the county. The Diablo Range occupies the extreme northeastern portion of this region and, like the Temblors, lies adjacent to the San Joaquin Valley.

2.2 Climate and Weather

The climate of the county can be generally characterized as Mediterranean, with warm, dry summers and cooler, relatively damp winters. Along the coast, mild temperatures are the rule throughout the year due to the moderating influence of the Pacific Ocean. This effect is diminished inland in proportion to distance from the ocean or by major intervening terrain features, such as the coastal mountain ranges. As a result, inland areas are characterized by a considerably wider range of temperature conditions. Maximum summer temperatures average about 70 degrees Fahrenheit near the coast, while inland valleys are often in the high 90s. Minimum winter temperatures average from the low 30s along the coast to the low 20s inland.

Regional meteorology is largely dominated by a persistent high pressure area which commonly resides over the eastern Pacific Ocean. Seasonal variations in the strength and position of this pressure cell cause seasonal changes in the weather patterns of the area. The Pacific High remains generally fixed several hundred miles offshore from May through September, enhancing onshore winds and opposing offshore winds. During spring and early summer, as the onshore breezes pass over the cool water of the ocean, fog and low clouds often form in the marine air layer along the coast. Surface heating in the interior valleys dissipates the marine layer as it moves inland.

From November through April the Pacific High tends to migrate southward, allowing northern storms to move across the county. About 90% of the total annual rainfall is received during this period. Winter conditions are usually mild, with intermittent periods of precipitation followed by mostly clear days. Rainfall amounts can vary considerably among different regions in the county. In the Coastal Plain, annual rainfall averages 16 to 28 inches, while the Upper Salinas River Valley generally receives about 12 to 20 inches of rain. The Carrizo Plain is the driest area of the county with less than 12 inches of rain in a typical year.

Airflow around the county plays an important role in the movement and dispersion of pollutants. The speed and direction of local winds are controlled by the location and strength of the Pacific High pressure system and other global patterns, by topographical features, and by circulation patterns resulting from temperature differences between the land and sea. In spring and summer months, when the Pacific High attains its greatest strength, onshore winds from the northwest generally prevail during the day. At night, as the sea breeze dies, weak drainage winds flow down the coastal mountains and valleys to form a light, easterly land breeze.

In the Fall, onshore surface winds decline and the marine layer grows shallow, allowing an occasional reversal to a weak offshore flow. This, along with the diurnal alternation of land-sea breeze circulation, can sometimes produce a "sloshing" effect. Under these conditions, pollutants may accumulate over the ocean for a period of one or more days and are subsequently carried back onshore with the return of the sea breeze. Strong inversions can form at this time, "trapping" pollutants near the surface.

This effect is intensified when the Pacific High weakens or moves inland to the east. This may produce a "Santa Ana" condition in which air, often pollutant-laden, is transported into the county from the east and southeast. This can occur over a period of several days until the high pressure system returns to its normal location, breaking the pattern. The breakup of a Santa Ana condition may result in relatively stagnant conditions and a buildup of pollutants offshore. Occasionally, the onset of the typical daytime sea breeze can bring these pollutants back onshore, where they combine with local emissions to cause high pollutant concentrations along the coast.

2.3 Land Use, Population and Economics

The predominant land use in San Luis Obispo County is agriculture, with the production and processing of vegetable crops, wine grapes, dryland grains and livestock as the major components. The southern and coastal areas of the county are primarily devoted to the production of row crops (strawberries, lettuce, broccoli, peas and other vegetables) and vegetable transplants, although cattle ranching prevails along the north coast. Vineyards, grain production, livestock grazing, and show and thoroughbred horse ranching are the dominant land uses in the Upper Salinas River Valley; the East County Plain supports some cattle ranches and dryland grain farms. Much of the county's agricultural land is property committed to agricultural use for periods of up to 20 years under the Williamson Act. In 2008, agricultural acreage totaled approximately 1,144,299 acres, with a gross crop value of $606,745,000. Production in the animal industry was valued at $53,848,000 for the same period. The largest change in agricultural uses in recent years has been a substantial increase in vineyard plantings for wine grapes. In 1998 there were 11,897 bearing acres; this increased to 36,662 bearing acres in 2008.

The county's urban areas exist as separate and uniquely distinct clusters of development. San Miguel, Templeton, Atascadero, Cambria, Cayucos, Los Osos, Oceano and Nipomo are primarily residential communities; of these Atascadero is the only incorporated city. In contrast, San Luis Obispo, Morro Bay, the Five Cities area and Paso Robles have a much broader mix of commercial and residential uses. Residential development has been limited in some areas of the county as a result of moratoriums, growth management issues, and resource constraints. The 2009 estimated population of the county was 266,971. The two largest cities in the county are San Luis Obispo at 42,963 (2006 est.) and Atascadero at 27,343 (2006 est.)

The City of San Luis Obispo is the county seat and commercial center of the region. Commercial and industrial development has been growing steadily in the northern areas of the county, particularly in Atascadero and Paso Robles.

3. OVERVIEW OF NETWORK OPERATION

3.1 Air Monitoring Network Design - Monitoring Objectives and Spatial Scales

Federal regulations require that a SLAMS network be designed to meet a minimum of six basic ambient air monitoring objectives:

1. To determine the highest concentration expected to occur in the area covered by the network;
2. To determine representative concentrations in areas of high population density;
3. To determine the impact on ambient pollution levels of significant sources or source categories;
4. To determine general background concentration levels;
5. To determine the extent of regional pollutant transport among populated areas, and in support of secondary standards.
6. To determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation).

The goal in designing a SLAMS network is to establish monitoring stations that will provide data to meet these monitoring objectives. The physical siting of the air monitoring station must achieve a spatial scale of representativeness that is consistent with the monitoring objective. The spatial scale results from the physical location of the site with respect to the pollutant sources and categories. It estimates the size of the area surrounding the monitoring site that experiences uniform pollutant concentrations. The categories of spatial scale are:

- Microscale - An area of uniform pollutant concentrations ranging from several meters up to 100 meters.
- Middle Scale – uniform pollutant concentrations in an area of about 110 meters to 0.5 kilometer.
- Neighborhood Scale – an area with dimensions in the 0.5 to 4 kilometer range.
- Urban Scale – Citywide pollutant conditions with dimensions of from 4 to 50 kilometers.
- Regional Scale – An entire rural area of the same general geography (this area ranges from tens to hundreds of kilometers).

Table 1: Relationship Among Monitoring Objectives and Scale of Representativeness.

Monitoring Objective	Appropriate Spatial Scale
Highest concentration	Micro, middle, neighborhood (sometimes urban)
Population	Neighborhood, urban
Source impact	Micro, middle, neighborhood
General/Background	Neighborhood, urban, regional
Regional transport	Urban, regional
Welfare-related impacts	Urban, regional

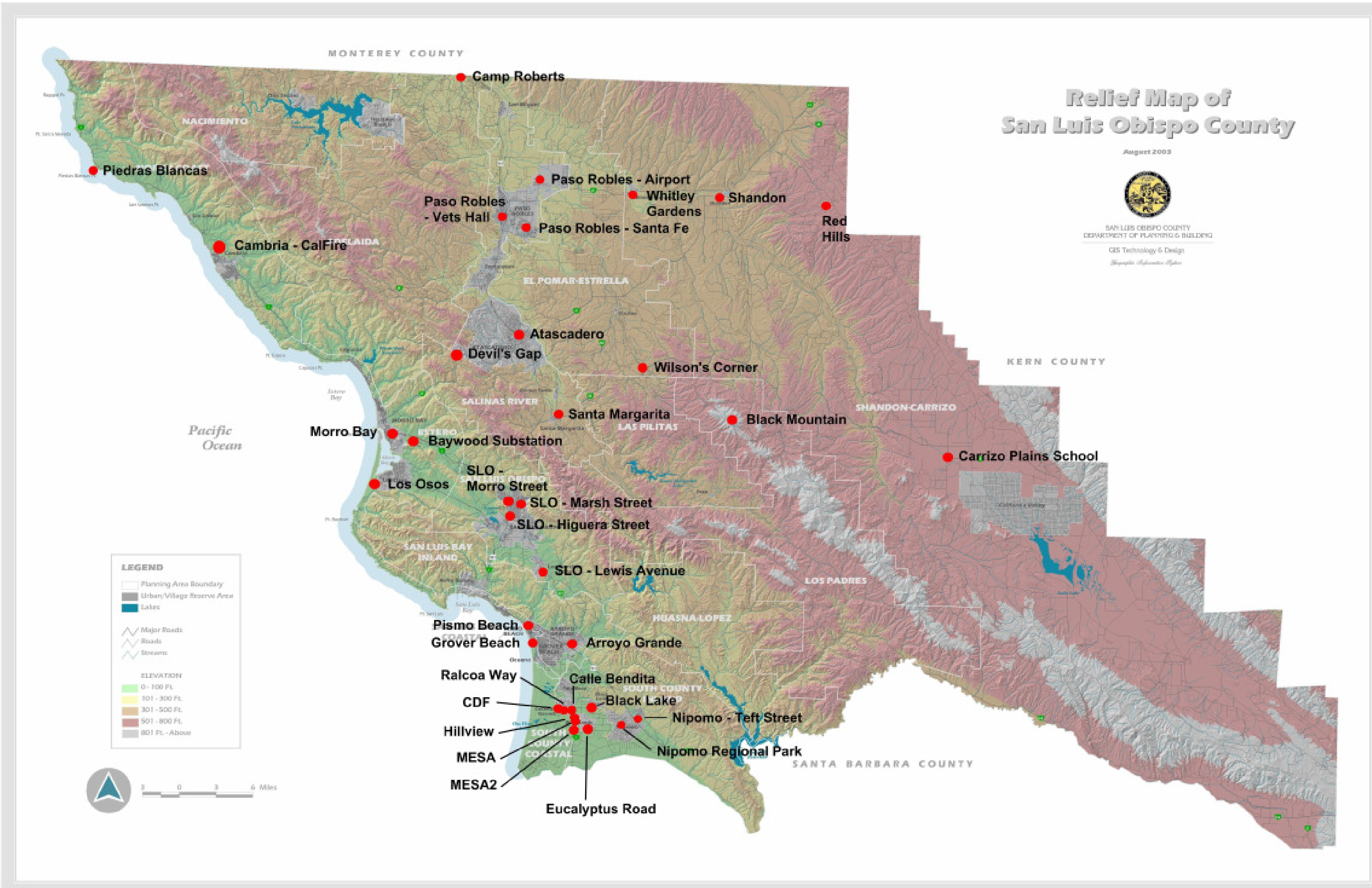

Figure 1: Historical Ambient Air Monitoring Locations in San Luis Obispo County

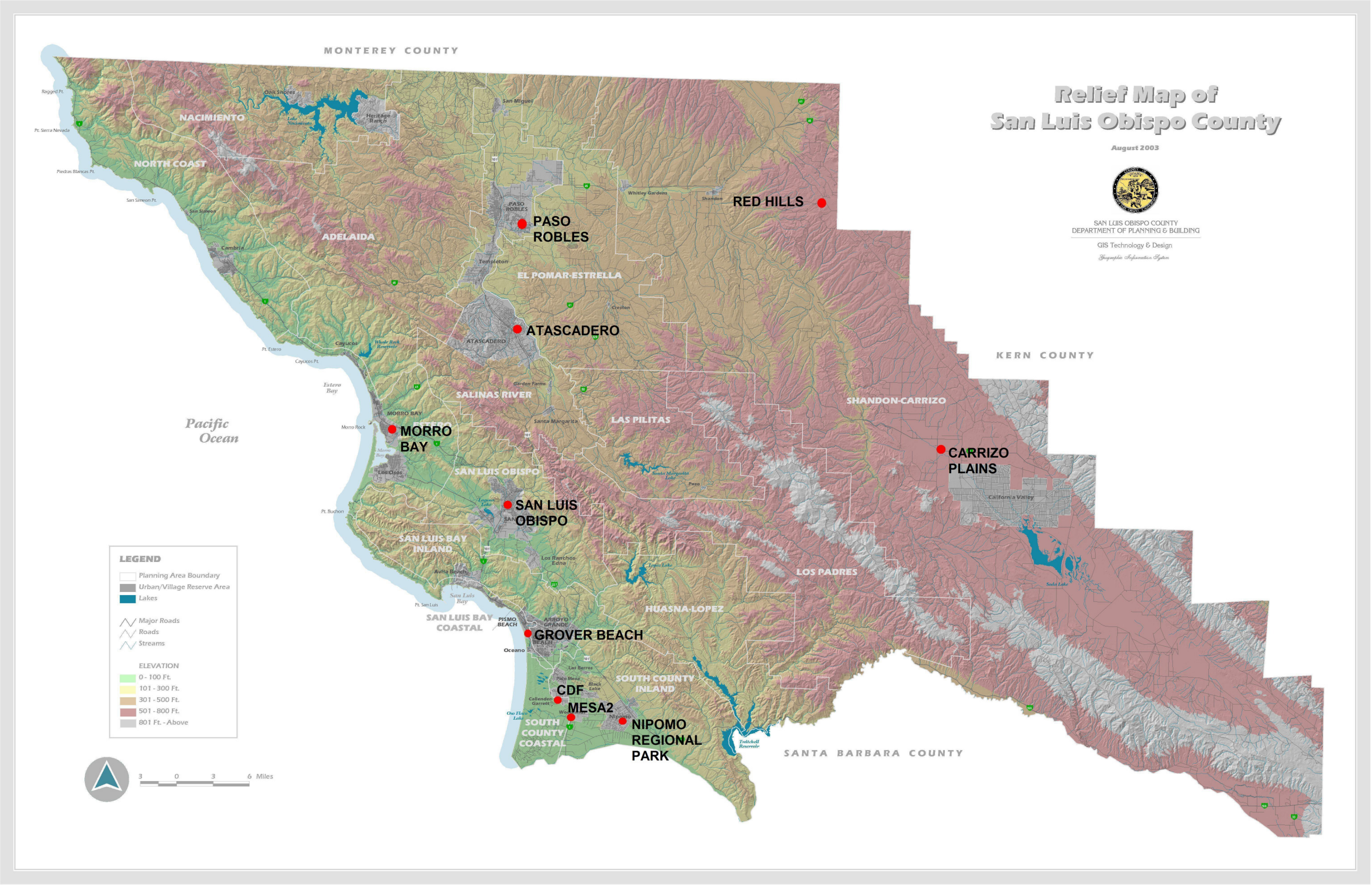

Figure 2: Ambient Air Monitoring Stations Operating in San Luis Obispo County in 2009/2010

3.2 Ambient Air Monitoring Network in San Luis Obispo County

Figure 1 shows a map of all historical ambient air monitoring locations dating back to 1976. Some of these sites were operated for a year or less in the first few years in which monitoring was conducted in the county to gauge the need for air quality surveillance at that location. Other sites were part of various studies the District has been involved in over the years such as the Central Coast Ozone Study, The San Joaquin Valley Air Quality Study/AUSPEX, the San Luis Obispo County Regional Ozone Study and a number of smaller short-term monitoring efforts. Lastly, the map includes monitoring stations still in operation. From viewing the map it is clear that all of the populated areas and most of the rural portions of the county have had ambient air monitoring performed at some time in the past. The existing monitoring site locations are the result of years of sampling and evaluating data to determine the optimum network configuration. The SLOAPCD air monitoring network is a dynamic system that can and should change with changing conditions.

Figure 2 shows a map of all currently operating ambient air monitoring stations in San Luis Obispo County. Table 2 lists these stations, the agency or company which operates them, the pollutant or meteorological parameters which are monitored at each location and the monitoring objective.

There are currently ten permanent ambient air monitoring stations in San Luis Obispo County. Eight of these stations are operated by the APCD as part of our SLAMS network. The ARB operates two stations in the county as part of their SLAMS network: one at Paso Robles and one in San Luis Obispo.

3.2.1 Ozone Monitoring Network

All ambient air monitoring stations in the county except for MESA2, CDF and Grover Beach monitor for ozone (see Table 2). The SLAMS network in San Luis Obispo County features ozone monitors located in Atascadero, Red Hills, Carrizo Plains, Paso Robles, Morro Bay, San Luis Obispo, and Nipomo.

Atascadero – Operated by the SLOAPCD since 1988, this population-oriented neighborhood scale ozone monitor is located near the central business district of downtown Atascadero and is bounded on two sides by elementary schools. It provides a measurement of representative ozone concentration for the City of Atascadero. Ozone concentrations at this site exhibit strong diurnal fluctuations caused by titration of ozone by oxides of nitrogen from nearby mobile and residential sources. Measured concentrations at this site are often similar to those recorded at Paso Robles and are some of the highest in the SLAMS network. The highest ozone concentrations at Atascadero occur when high pressure over the interior southwest U.S. causes transport of “old” ozone and other pollutants into SLO County from the east. Under these infrequent conditions transported ozone enhanced by local pollutants can cause highly elevated concentrations. The prevailing West or Northwest winds from the coast help keep ozone levels at Atascadero low most of the time.

Paso Robles – Operated by ARB since 1974, this population-oriented neighborhood scale ozone monitor provides a representative ozone concentration for the suburban areas of the City of Paso Robles. The conditions under which elevated ozone levels occur and the location’s prevailing winds are similar to Atascadero. NOx monitoring is not performed at this site so the degree of removal of ambient ozone by titration is not known here, but is believed to be similar to that of other cities in the county.

Morro Bay – Operated since 1975 by SLOAPCD, this site provides regional scale and General/Background ozone monitoring. Located in downtown Morro Bay, the monitor generally measures background levels of ozone from the predominant northwest winds blowing off of the Pacific Ocean. Under unusual meteorological conditions noted in section 2.2 the Morro Bay site can record elevated ozone concentrations transported from urban areas as far south as the Los Angeles basin.

San Luis Obispo – Operated by ARB since 1970, this population-oriented, neighborhood scale ozone monitor provides a representative ozone concentration for the City of San Luis Obispo. The monitor is located in the urban area where ozone concentrations are significantly affected by the process of depletion by titration with local mobile and stationary NOx sources. As a result the concentrations recorded here are often lower than at Morro Bay.

Nipomo Regional Park – Operated by SLOAPCD since 1998, this station provides monitoring of background levels of ozone on a regional scale. The station was relocated in 1998 from Wilson Street several miles away. The ozone concentrations measured here are representative of interior portions of the Nipomo Mesa and are the highest recorded in the coastal region of San Luis Obispo County.

Red Hills – Operated by SLOAPCD since 2000, this station is located on the summit of the Red Hills near the community of Shandon at an elevation of about 2000 feet. This site consistently records the highest and most persistent ozone concentrations in the county.

Carrizo Plains – Operated by SLOAPCD since January 2006 this station monitors background levels and ozone transport on a regional scale. The monitor is located in an outbuilding at the Carrizo Plains School. The ozone concentrations recorded here are second only to Red Hills in concentration and persistence.

The SLAMS monitoring objectives met by the existing ozone network are:

1) Highest Concentration – The Red Hills and Carrizo Plains stations consistently record the highest ozone concentrations in the county. The high ozone levels tend to occur in the interior areas of the county during summer, either following long periods of wind stagnation, or as a result of offshore winds which can transport pollutants from interior regions to the northeast.
2) High Population Exposure – The Paso Robles, Atascadero and San Luis Obispo monitors provide a good representation of the ozone levels in the major cities of the county.
3) Source Impact – Because ozone is a secondary pollutant the effect of emissions from any single source are experienced 5 to 7 hours later and often many miles distant. As a regional pollutant, monitoring for specific sources of ozone is not performed.
4) General/Background – The monitors at Morro Bay and Nipomo Regional Park provide regional background ozone levels.
5) Regional Transport – The stations located at Carrizo Plains and Red Hills provide excellent surveillance of regional transport of ozone in the interior part of the county. Coastal monitoring stations have provided evidence in the past of regional transport of ozone over water from distant urban sources.

Welfare-related impacts are not currently addressed in the District's SLAMS ozone network and are not thought to be significant.

3.2.2 Nitrogen Dioxide Monitoring Network

The SLAMS network in San Luis Obispo County features nitrogen dioxide (NO_2) monitors at Atascadero, Morro Bay, and Nipomo Regional Park. NO_2 levels have always been well below the state and federal standards at all locations in our county. For this reason, except in the case of Morro Bay, NO_2 monitoring is most useful here as an indicator of depletion of ambient ozone through titration with nitric oxide. Having at least one NO_2 monitor in each geographical region of the county also serves a long-term air quality surveillance role.

Atascadero – Operated by SLOAPCD since 1990, this population-oriented monitor is considered neighborhood scale and highest concentration for $NO_{2.}$ This, the only NO_2 monitor in the Salinas River air basin, records the highest NO, NO_2 and NOx levels in the county. The monitor's location downtown has established a strong diurnal inverse relationship between ozone and NO_2 levels caused by local mobile sources and residential and commercial combustion of natural gas.

Morro Bay – Operated by SLOAPCD since 2001 this monitor is neighborhood scale and monitors emissions from a specific source: the Morro Bay power plant, located less than a mile upwind.

Nipomo Regional Park – Operated by the SLOAPCD since 1998, this monitor is regional in scale and is representative of background concentrations on the Nipomo Mesa. The site's location in a large natural area away from local or mobile sources makes it ideal for regional surveillance of NO_2. NO_2 monitoring had also been performed at the previous location of the Nipomo monitoring station on Wilson Street.

The SLAMS monitoring objectives met by the existing NO_2 network are:

1) Highest Concentration – The Atascadero monitor historically has measured the highest NO_2 concentrations in the county. NO_2 levels are the result of titration of ambient ozone by local sources of nitric oxide and as a result values are always relatively low.
2) General/Background – With no significant local sources present the monitor at Nipomo Regional Park provides an excellent measure of background NO_2 levels on the Nipomo Mesa.
3) Source Impact – The monitor at Morro Bay is placed to monitor local impacts of emissions from the Morro Bay Power Plant, the single greatest stationary source of oxides of nitrogen in the county.

Regional Transport and Welfare-Related impacts of NO_2 are not currently addressed by the District's SLAMS network and are not thought to be significant.

Table 2: Ambient Air Quality Parameters Monitored in San Luis Obispo County in 2009/2010

	O_3	NO	NO_2	NOx	SO_2	PM_{10}	$PM_{2.5}$	TEOM	WS	WD	ATM
APCD Stations											
Atascadero	P	P,C	P,C	P,C		P	P		X	X	X
Morro Bay	B	S	S	S		P			X	X	
Nipomo Regional Park	B	B	B	B		P			X	X	X
Grover Beach									X	X	
MESA2					S	S			X	X	X
CDF								S	X	X	
Carrizo Plains	B								X	X	X
Red Hills	C								X	X	X
ARB Stations											
San Luis Obispo	P					P	P		X	X	X
Paso Robles	P					P			X	X	X

Acronyms:

C Maximum Concentration; P Population; S Source; B Background Concentration

- O_3 Ozone
- NO Nitric Oxide
- NO_2 Nitrogen Dioxide
- NOx Oxides of Nitrogen
- SO_2 Sulfur Dioxide
- CO Carbon Monoxide
- TEOM Particulates <10 microns (monitored continuously)
- PM_{10} Particulates < 10 microns (samples every sixth day)
- $PM_{2.5}$ Particulates < 2.5 microns (samples every sixth day)
- WS Wind Speed
- WD Wind Direction
- ATM Ambient Temp

Table 3: Air Quality Parameters and Monitoring Objectives in SLO County in 2009/2010

	Parameter	Monitoring Objective				
		Highest Conc.	Pop.	Source	General Background	Transport
OZONE	Atascadero		x			
	Morro Bay				x	
	Nipomo				x	
	Carrizo				x	x
	Red Hills	x				x
	SLO		x			
	Paso		x			
NITROGEN DIOXIDE	Atascadero	x	x			
	Morro Bay			x		
	Nipomo				x	
SULFUR DIOXIDE	Mesa 2	x	x	x		
PARTICULATES	Atascadero		x			
	Morro Bay				x	
	Nipomo		x			
	SLO		x			
	Paso		x			
	MESA2	x		x		
	CDF			x		

3.2.3 Sulfur Dioxide Monitoring Network

The sulfur dioxide (SO_2) monitoring network in San Luis Obispo County currently consists of one station: MESA2. More extensive SO_2 monitoring has been performed in the past and included monitors at Nipomo, Morro Bay, Grover Beach and (in now-decommissioned stations at MESA and Ralcoa Way) on the Nipomo Mesa.

MESA2 – Operated by the APCD since 2006 this monitor performs surveillance of a nearby oil refinery. It is considered middle scale and highest concentration for SO_2. Since it is located close to a major source for SO_2 emissions it is representative only of the immediate locality. The station was sited to optimize surveillance of the nearby coke calciner which has recently shut down. The highest historical SO_2 levels were measured at the two decommissioned stations: MESA and Ralcoa Way.

The SLAMS SO_2 monitoring objectives met by the network are:

1) Highest Concentration – The monitor at MESA2 currently records the highest SO_2 levels in the county. Higher historical levels were measured at two nearby but now decommissioned stations: MESA and Ralcoa Way. The Mesa 2 station is not optimally sited for measuring the highest possible SO_2 concentrations from the nearby refinery.

2) Source Impact – The monitor at MESA2 is invaluable in determining the SO_2 source impact upon the region.

Monitoring objectives not addressed by the existing SO_2 network are: General/Background; Population; Regional Transport; and Welfare-Related. Historical SO_2 monitoring performed elsewhere in the county has provided good evidence that monitoring for these objectives is not needed

3.2.4 PM_{10} and $PM_{2.5}$ Particulate Monitoring Network

The particulate monitoring network in San Luis Obispo County consists of PM_{10} monitors (at Paso Robles, Atascadero, Morro Bay, San Luis Obispo, Mesa 2, CDF and Nipomo Regional Park) and $PM_{2.5}$ monitors (at Atascadero, Mesa2 and San Luis Obispo). The PM_{10} network has been in place since 1988. Originally, all particulate monitoring in the county was performed as part of ARB's network. In the past ten years, however, the District's PM_{10} sampling program has become independent with our own processing facilities and operating procedures. Today, the Paso Robles and San Luis Obispo PM_{10} samplers remain part of ARB's network while all other samplers in the county are in the District's network. The $PM_{2.5}$ FRM monitors at Atascadero were part of the ARB network but were operated by the SLOAPCD. The $PM_{2.5}$ samplers began operation in 1999 in response to the establishment of a new federal particulate standard for $PM_{2.5}$ in 1997 and were replaced by a single BAM 1020a $PM_{2.5}$ monitor in May 2009.

Paso Robles – Operated by ARB since 1991 this PM_{10} monitor is urban in scale and representative of the city of Paso Robles.

Atascadero – Operated by SLOAPCD. The PM_{10} monitor has been operated since 1988. The collocated RFM $PM_{2.5}$ monitors began operation in 1999 and were replaced by a single BAM 1020a continuous monitor in May 2009. The FRM samplers were taken offline in March 2010. All are urban in scale and representative of particulate concentrations in the city of Atascadero.

Morro Bay – Operated by SLOAPCD since 1986. This monitor is neighborhood scale and representative of particulate concentrations in Morro Bay. The monitor was originally placed to measure source impacts from the Morro Bay power plant. Due to the monitors proximity to the coast it is possibly biased by the particulate present in marine aerosols.

San Luis Obispo – Operated by ARB, the PM_{10} sampler has been in place since 1988, and the $PM_{2.5}$ sampler since 1999. These population-oriented monitors are neighborhood in scale and represent particulate concentrations in the City of San Luis Obispo.

MESA2 – Operated by the APCD since 2006, this site featured collocated PM_{10} samplers which were replaced by a single BAM 1020a PM_{10} monitor in June 2009. A BAM 1020a $PM_{2.5}$ sampler was installed at the same time. This site monitors source impacts from the nearby oil refinery and coastal dunes and is middle scale. These monitors record some of the highest particulate levels in the county and are thought to be strongly influenced by their proximity to extensive coastal sand dunes and the Oceano Dunes State Vehicular Recreation Area (ODSVRA) in the direction of the prevailing wind.

CDF – Originally established for the Nipomo Mesa Phase 2 Particulate Study, this site has become a permanent part of our SLAMS particulate network. The site features a TEOM PM_{10} monitor which is neighborhood in scale and measures source impacts from the ODSVRA.

Nipomo Regional Park – Operated at this location by SLOAPCD since 1998, it was previously located at Wilson Street in Nipomo where it had been in place since 1990. At this location the monitor is regional in scale and is representative of PM_{10} concentrations on the Nipomo Mesa.

4.0 STATISTICAL ANALYSIS

Four statistical tests were run to examine the comprehensiveness and suitability of the SLOAPCD monitoring network. These tests and the results are described below.

4.1 Measured Concentration Analysis

Individual monitors are ranked based on the concentration of pollutants they measure. Monitors that measure high concentrations or design values are ranked higher than monitors that measure low concentrations. Results can be used to determine which monitors are less useful in meeting the monitoring objective. Three-year average design values were calculated for the period 2007 to 2009 for ozone and $PM_{2.5}$. For PM_{10} the annual arithmetic mean for 2009 was used. Monitors were grouped according to their monitoring objective and ranked within that group. The results of the measured concentration analysis are presented in Tables 4, 5 & 6.

4.1.1 Ozone Measured Concentration Analysis

In Table 4 the analysis broke out three groups based on monitoring objective. Red Hills was appropriately ranked #1 for transport/highest concentration.

Of the three population-oriented monitors only Atascadero and Paso Robles are in the same air basin. Although the sites are very similar, Atascadero records the highest concentrations of ozone and would be the monitor to retain if one were to be dropped. The monitor at Paso Robles is part of the ARB network, however, and cannot be changed by the District.

Three ozone monitors were grouped as background-oriented monitors. All three monitors will be retained because they are in different air basins and the information they provide is unique and useful.

Table 4: Ozone Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value (ppm)	Monitoring Objective	Spatial Scale	Rank
Red Hills	3601 Gillis Canyon Road	06-079-8005	.084	Transport/Highest Concentration	Residential	1
Atascadero	6005 Lewis Avenue	06-079-8001	.066	Population	Population	1
Paso Robles	235 Santa Fe Avenue	06-079-0005	.064	Population	Urban	2
San Luis Obispo	3220 South Higuera Street	06-079-2006	.059	Population	Urban	3
Carrizo Plains School	9640 Carrizo Highway	06-079-8006	.080	Background	Residential	1
NRP	Nipomo Regional Park	06-079-4002	.061	Background	Residential	2
Morro Bay	Morro Bay Blvd & Kern	06-079-3001	.056	Background	Residential	3

4.1.2 $PM_{2.5}$ Measured Concentration Analysis

Table 5 presents the ranking of PM2.5 monitors. The Mesa2 monitor had insufficient data for this test. Although Atascadero ranked higher than San Luis Obispo in this analysis the samplers are in different air basins and so both should be retained. The Atascadero and San Luis Obispo monitors are both part of the ARB network.

Table 5: PM2.5 Measured Concentration Analysis

Site	Address	AQS Site Code	Design Value (ug)	Monitoring Objective	Spatial Scale	Rank
Atascadero	6005 Lewis Avenue	06-079-8001	8.4	Population	Urban	1
San Luis Obispo	3220 South Higuera Street	06-079-2006	6.8	Population	Urban	2
Mesa2	1300 Guadalupe Road	06-079-2004	Insufficient data	Source	Middle	n/a

4.1.3 PM_{10} Measured Concentration Analysis

The analysis ranked monitors within three categories based on monitoring objective. The two source-oriented monitors are in place to perform surveillance of a significant area source of fine particulate at the Oceano Dunes SVRA and are both important to this task.

As was the case with ozone, of the three population-oriented monitors only Atascadero and Paso Robles are in the same air basin. Although the sites are very similar, Atascadero records the highest concentrations of particulate and would be the monitor to retain if one were to be dropped. The monitor at Paso Robles is part of the ARB network, however, and cannot be changed by the District.

The background-oriented monitor at Morro Bay samples boundary conditions on the coast while the monitor at NRP samples coastal interior conditions.

Table 6: PM10 Measured Concentration Analysis

Site	Address	AQS Site Code	Annual Arithmetic Mean 2009	Monitoring Objective	Spatial Scale	Rank
Mesa2	1300 Guadalupe Road, Arroyo Grande	06-079-2004	24.8	Source	Middle	1
CDF	2391 Willow Road, Arroyo Grande	06-079-2007	Insufficient data	Source	Neigh-borhood	n/a
Atascadero	6005 Lewis Avenue, Atascadero	06-079-8001	17.4	Population	Urban	1
Paso Robles	235 Santa Fe Avenue, Paso Robles	06-079-0005	16.2	Population	Urban	2
San Luis Obispo	3220 South Higuera Street, San Luis Obispo	06-079-2006	14.6	Population	Urban	3
Morro Bay	Morro Bay Blvd & Kern, Morro Bay	06-079-3001	20.9	Background	Resi-dential	1
NRP	Nipomo Regional Park, Nipomo	06-079-4002	20.2	Background	Resi-dential	2

4.2 Monitor to Monitor Correlation Analysis

Concentrations at one monitor are compared to concentrations measured at other monitors to determine if concentrations correlate temporally. Monitor pairs with correlation coefficient values near one are highly correlated and are ranked lower than those with correlation coefficient values closer to zero. Monitors that do not correlate well with other monitors exhibit unique temporal concentration variation relative to other monitors and are likely to be important for assessing local emissions, transport and spatial coverage. Monitors with concentrations that correlate well (e.g., $r^2 > 0.75$) with concentrations at another monitor may be redundant.

4.2.1 Correlation of Ozone Monitors in San Luis Obispo County

Figure 3 below depicts a correlation matrix comparing ozone monitors from San Luis Obispo and adjoining counties. The analysis reveals a significant correlation between ozone monitor pairs at Atascadero/Paso Robles, Morro Bay/San Luis Obispo and Red Hills/Carrizo Plains.

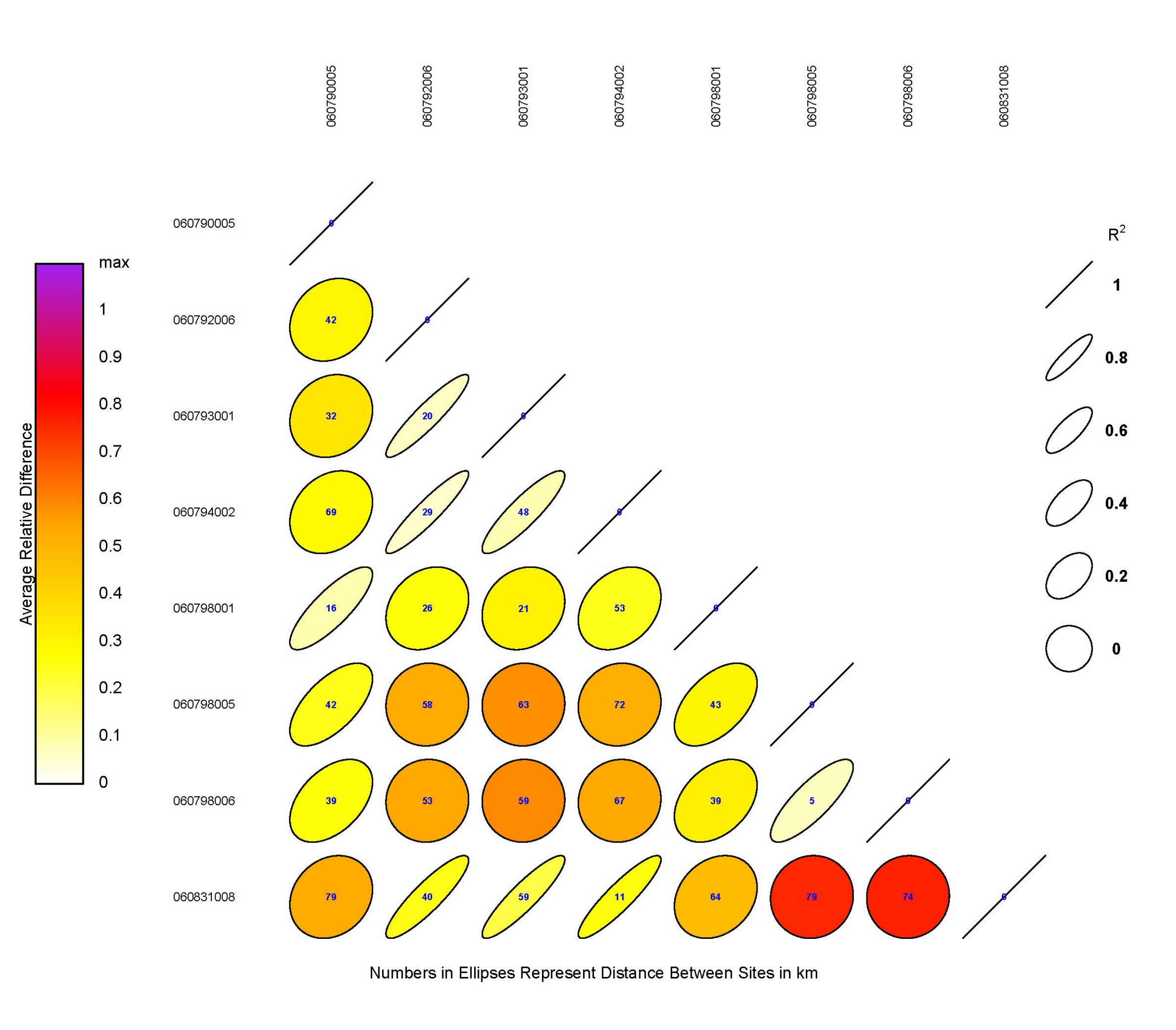

Figure 3: Correlation of Ozone Monitors in San Luis Obispo County

4.2.2 Correlation of FRM PM2.5 Monitors in San Luis Obispo County

Figure 4 depicts a correlation matrix comparing FRM PM2.5 monitors from San Luis Obispo and adjoining counties. There are only two FRM monitors in San Luis Obispo County (at Atascadero and San Luis Obispo) which are in different air basins. As a result they do not correlate well with each other and are not candidates for modification.

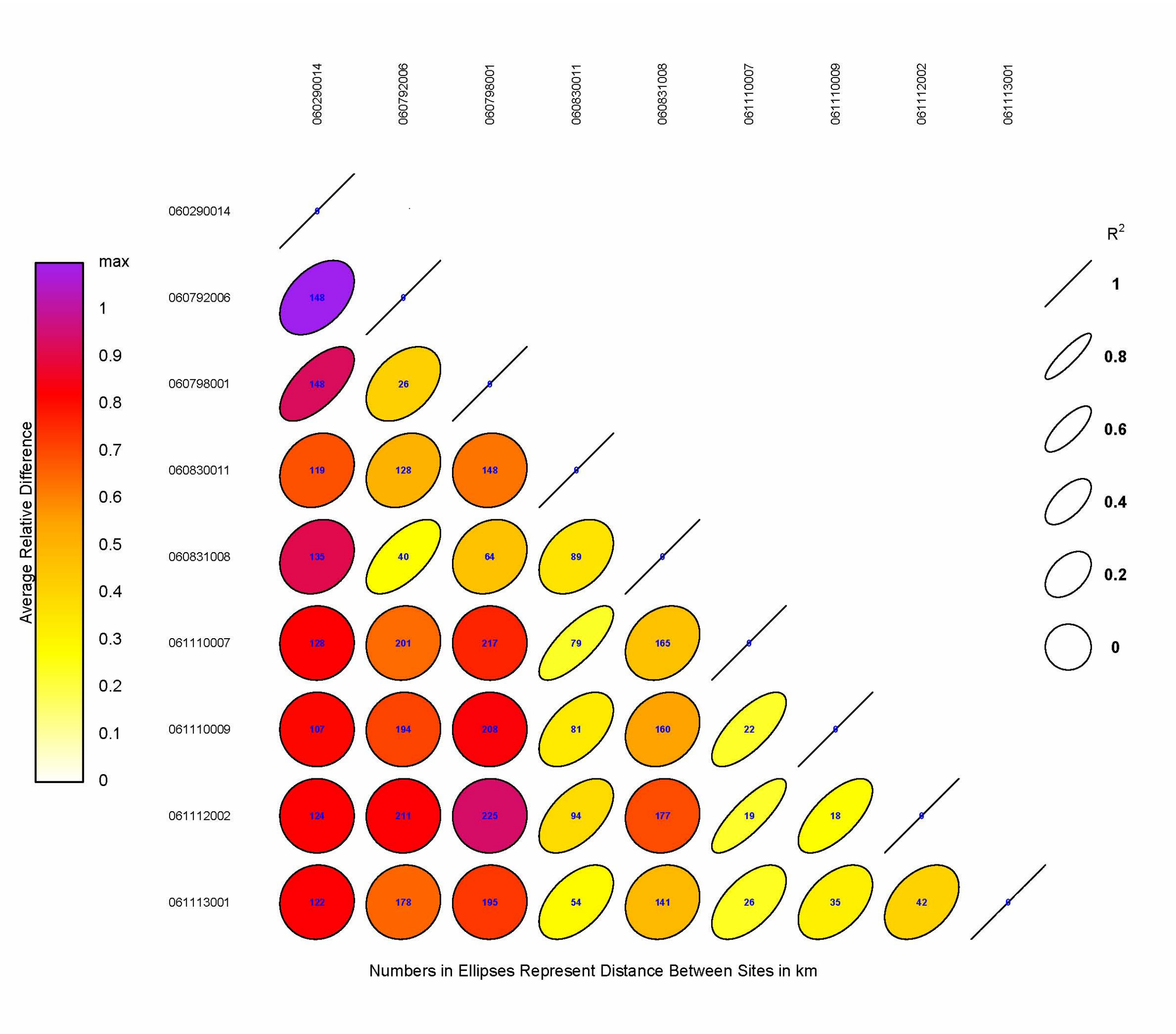

Figure 4: Correlation of FRM PM2.5 Monitors in San Luis Obispo County

4.2.3 Correlation of PM10 Monitors in San Luis Obispo County

Figure 5 depicts a correlation matrix comparing PM10 monitors from San Luis Obispo and adjoining counties. The analysis reveals a significant correlation between monitor pairs at Atascadero/Paso Robles, Morro Bay/San Luis Obispo and Nipomo Regional Park /San Luis Obispo.

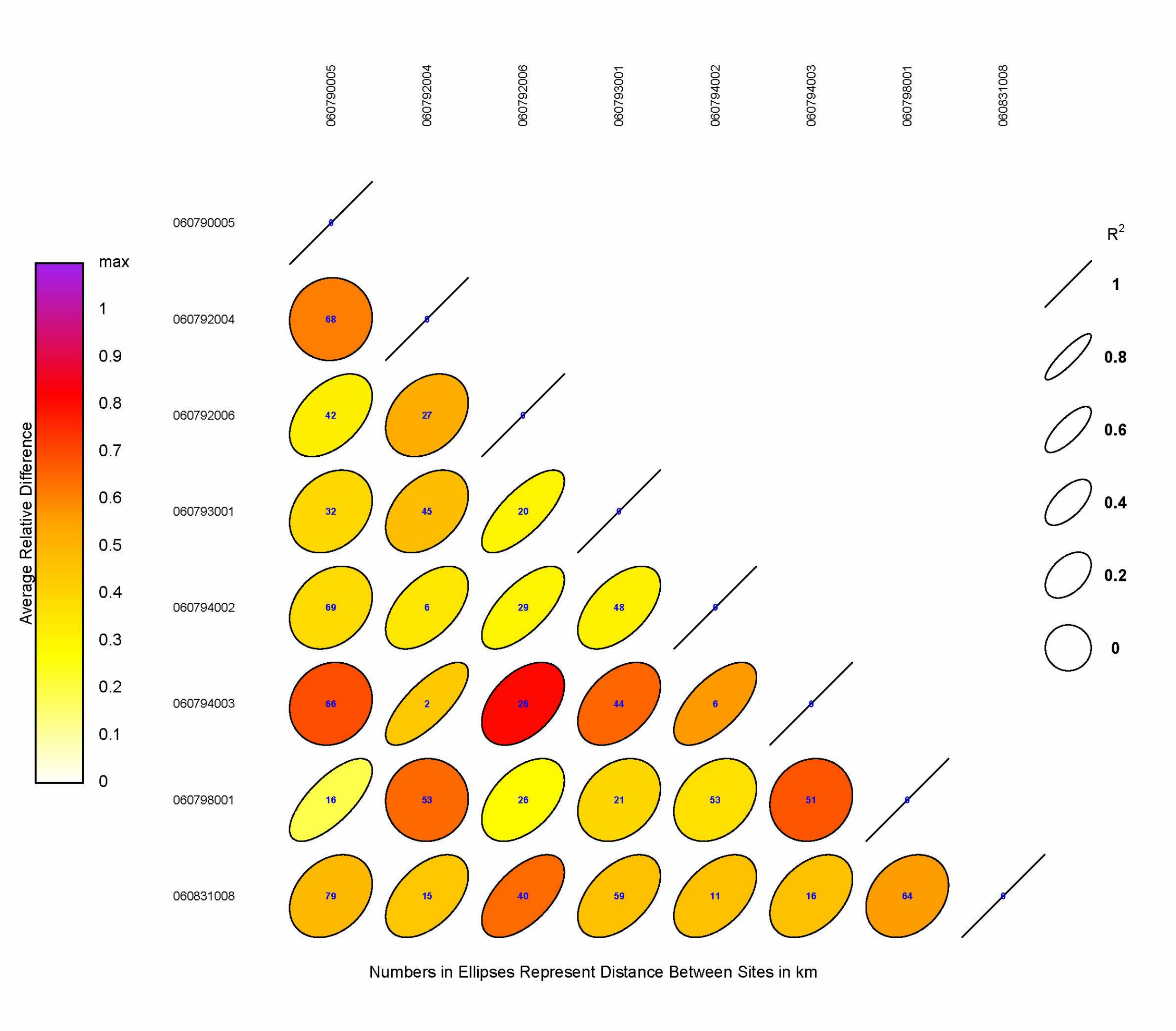

Figure 5: Correlation of PM10 Monitors in San Luis Obispo County

4.3 New Sites Analysis

The new sites analysis provides a way to determine areas where new sites could provide more information to characterize air quality. This is done using a series of criteria between neighboring sites to filter out those site pairs which meet the criteria for "placing" a new site. These criteria include the squared Pearson correlation between sites, the distance between sites, and the average difference between sites. In order to relate the positioning of potential new sites back to the NAAQS a final criterion related to the potential of exceeding 85% of the NAAQS is also accounted for.

The output of the analysis is a Google Earth graphic which depicts existing sites as red or grey circles and proposed “new” sites as yellow dots. The “new” sites are located in a corridor midway between ozone monitor pairs which are significantly different and suggest the possible location of new monitors.

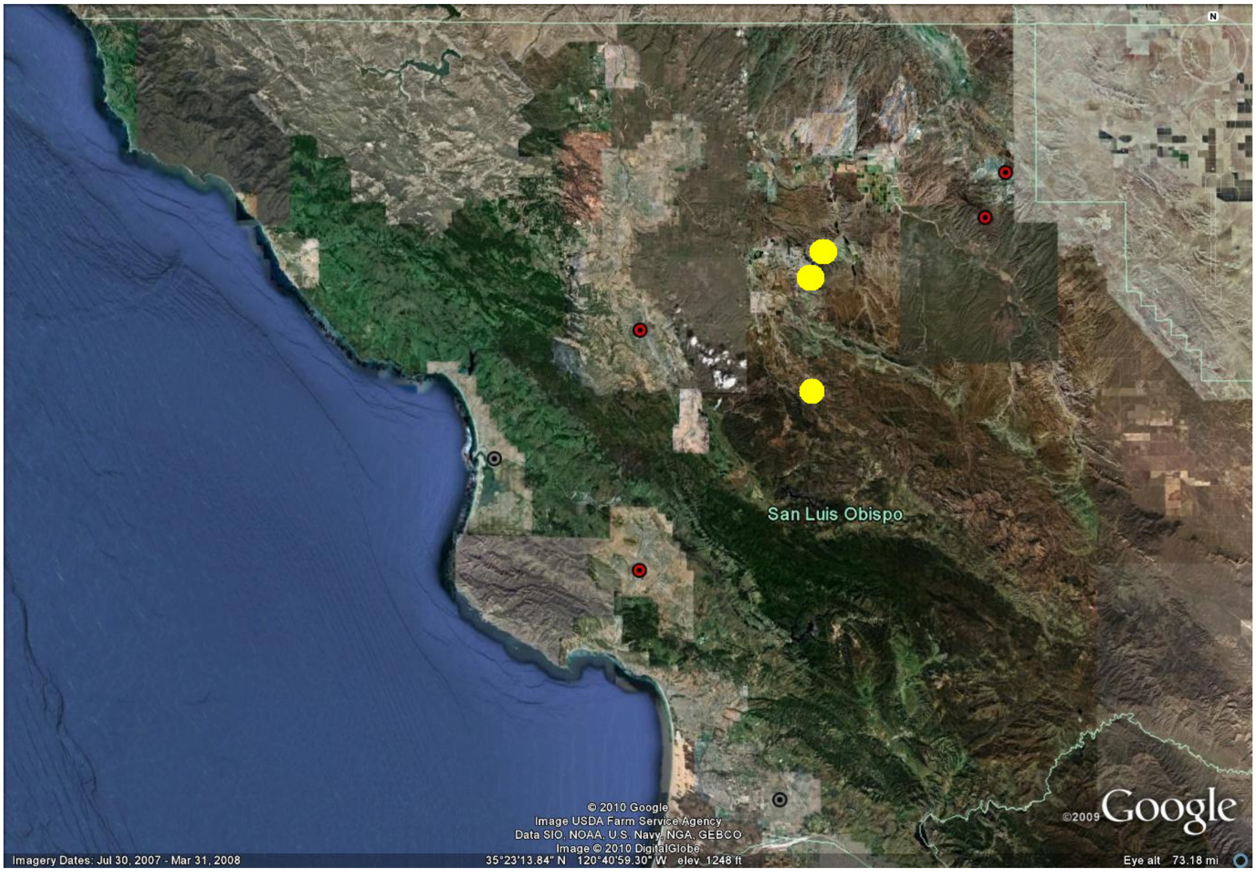

Figure 6: New Sites Analysis for Ozone

Figure 6 depicts the new sites analysis for ozone. The analysis identified three possible new locations for ozone monitors based on the significant differences between interior monitoring sites at Carrizo Plains and Red Hills with Sites at Atascadero and San Luis Obispo. In this case the difference between site pairs is primarily due to the monitor locations. The San Luis Obispo, Atascadero and Carrizo Plains/Red Hills monitors are located in three different air basins: the coastal, Salinas and interior. These three basins have significantly different climates and pollutant characteristics which render them incomparable. The proposed new sites are all located in the sparsely inhabited mountain region separating the air basins and would not be expected to provide any unique or useful air quality information

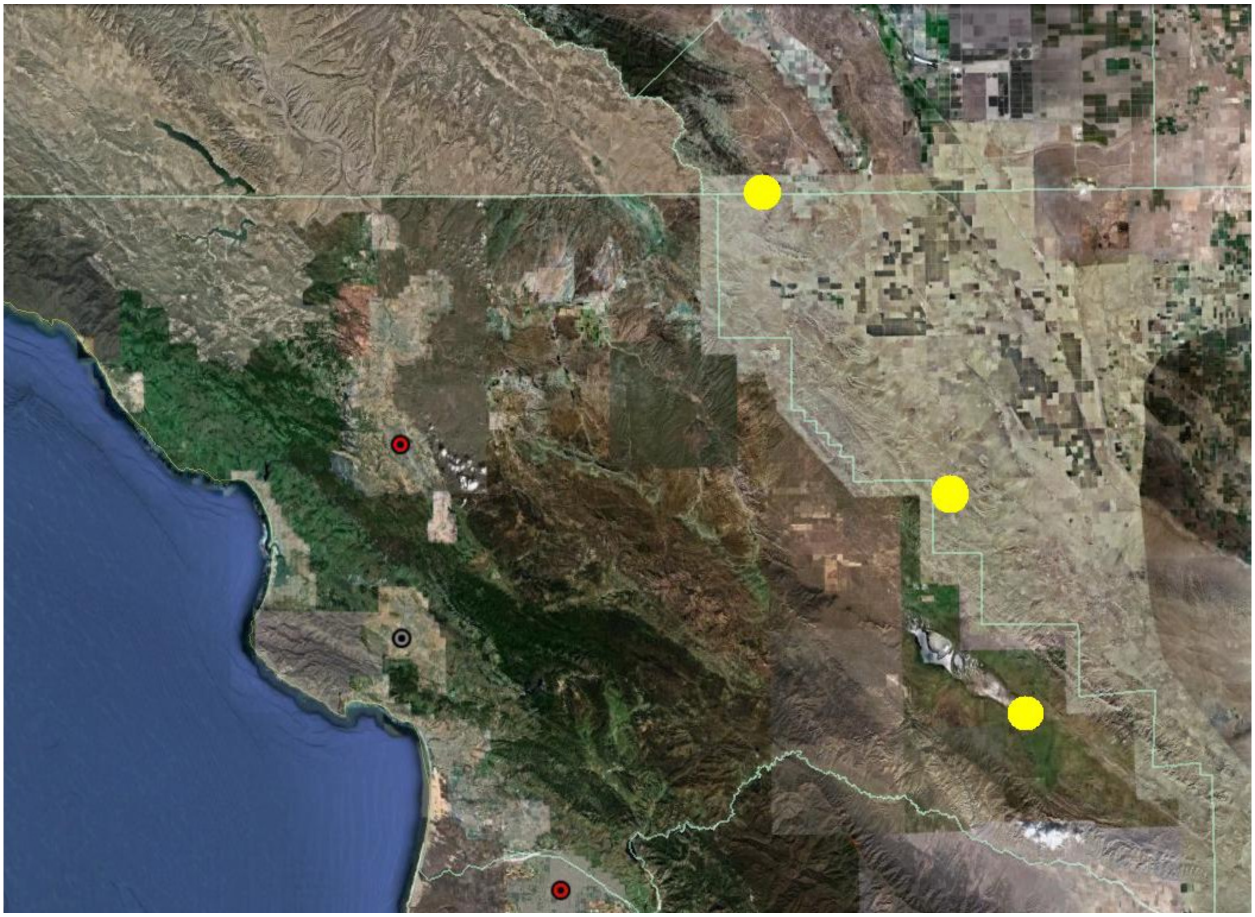

Figure 7: New Sites Analysis for FRM PM2.5

Figure 7 depicts the new sites analysis for FRM PM2.5. The analysis identified one possible new location for an FRM monitor in the Carrizo Plains based on the significant difference between monitors at Atascadero and the nearest site pair located in Southern California.

An assessment of the level of PM10 air pollution in the Carrizo Plains was done in 2006. One year of PM10 monitoring was conducted at the Carrizo Plains School using a standard hi-volume sampler running on a 1-in-6 day schedule. The monitoring results showed that there was no significant difference between the values measured at Atascadero and Carrizo Plains and that the Atascadero data may be used to interpolate PM10 concentrations on the Carrizo Plains.

The Carrizo Plains region experiences relatively low PM10 concentrations and is very similar in this respect with the Upper Salinas Basin and the existing site at Atascadero. This suggests that the placing an additional PM2.5 monitor would not provide unique and useful information.

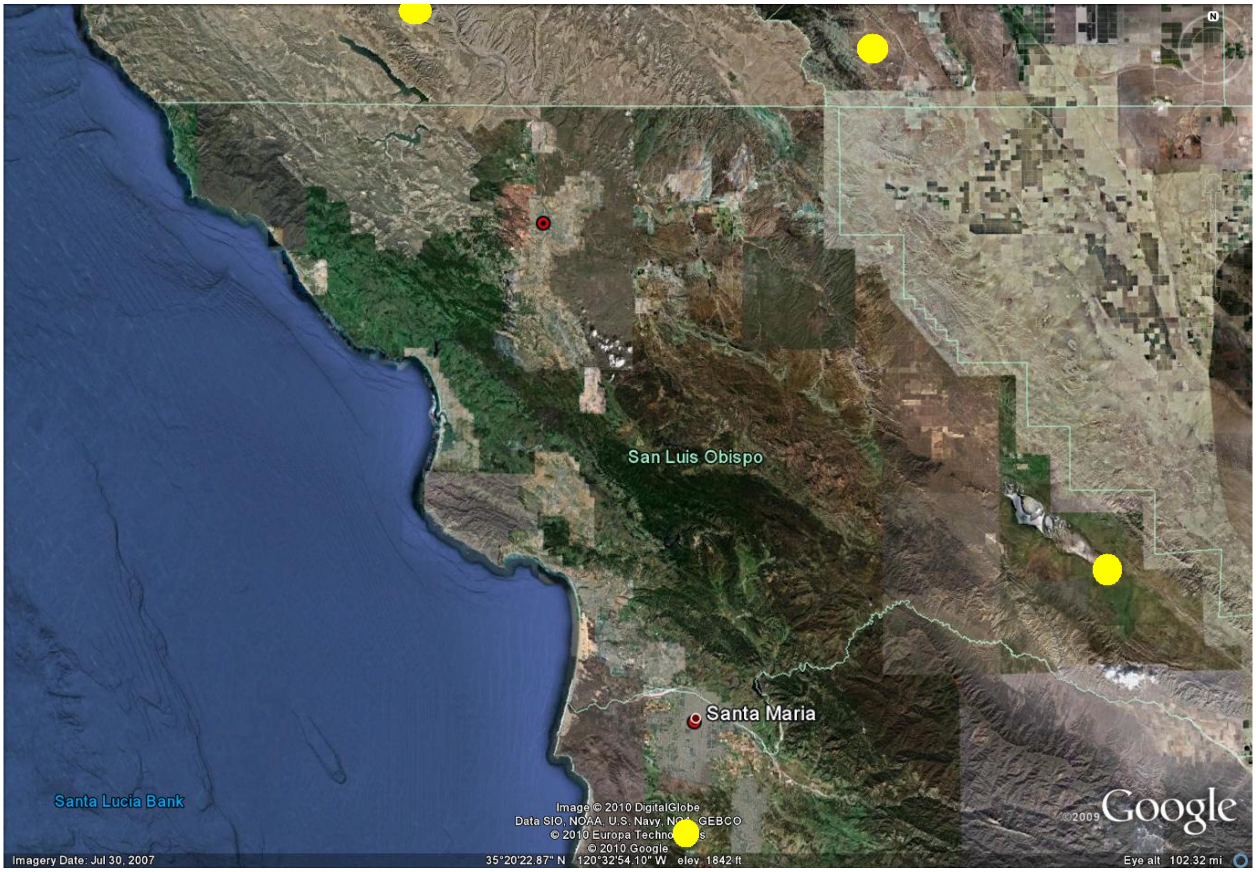

Figure 8: New Sites Analysis for PM10

Figure 8 depicts the new sites analysis for PM10. The analysis identified one possible new location for a PM10 monitor in the Carrizo Plains based on the significant difference between the monitor at Atascadero and the nearest site pair located in Southern California. An assessment of the level of PM10 air pollution in the Carrizo Plains was done in 2006. One year of PM10 monitoring was conducted at the Carrizo Plains School using a standard hi-volume sampler running on a 1-in-6 day schedule. The monitoring results showed that there was no significant difference between the values measured at Atascadero and Carrizo Plains and that the Atascadero data may be used to interpolate PM10 concentrations on the Carrizo Plains. For this reason locating a new PM10 monitor on the Carrizo Plains would be redundant.

4.4 Area Served Analysis

This exercise uses a spatial analysis technique known as Voronoi or Thiessen polygons to show the area represented by a monitoring site. The shape and size of each polygon is dependent on the proximity of the nearest neighbors to a particular site. The output of the analysis is a Google Earth image which displays each polygon along with the monitor within it.

Figures 9 and 10 depict the results of this analysis for PM10 and ozone respectively. The analyses for both PM10 and ozone indicate that the network is comprehensive and adequately covers population centers, rural areas and air basins of the county. Prior analyses have shown that the PM10 monitoring at Atascadero can be used to interpolate concentrations in the county's interior.

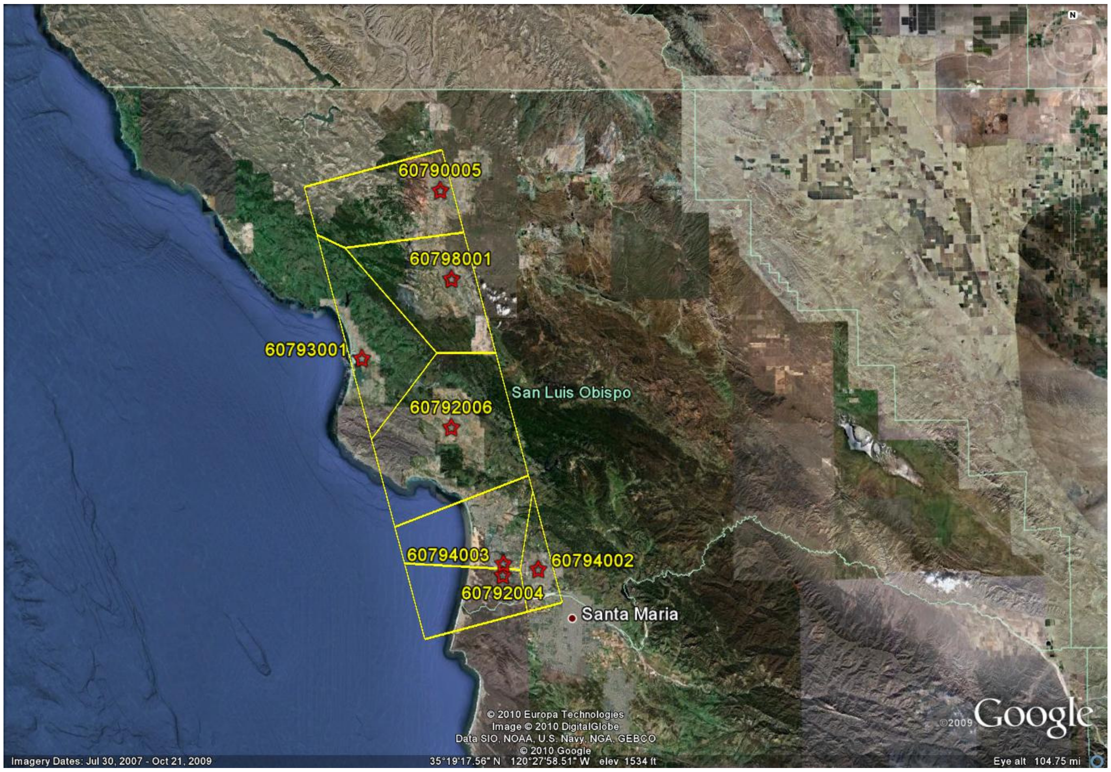

Figure 9: Area Served Analysis for PM10

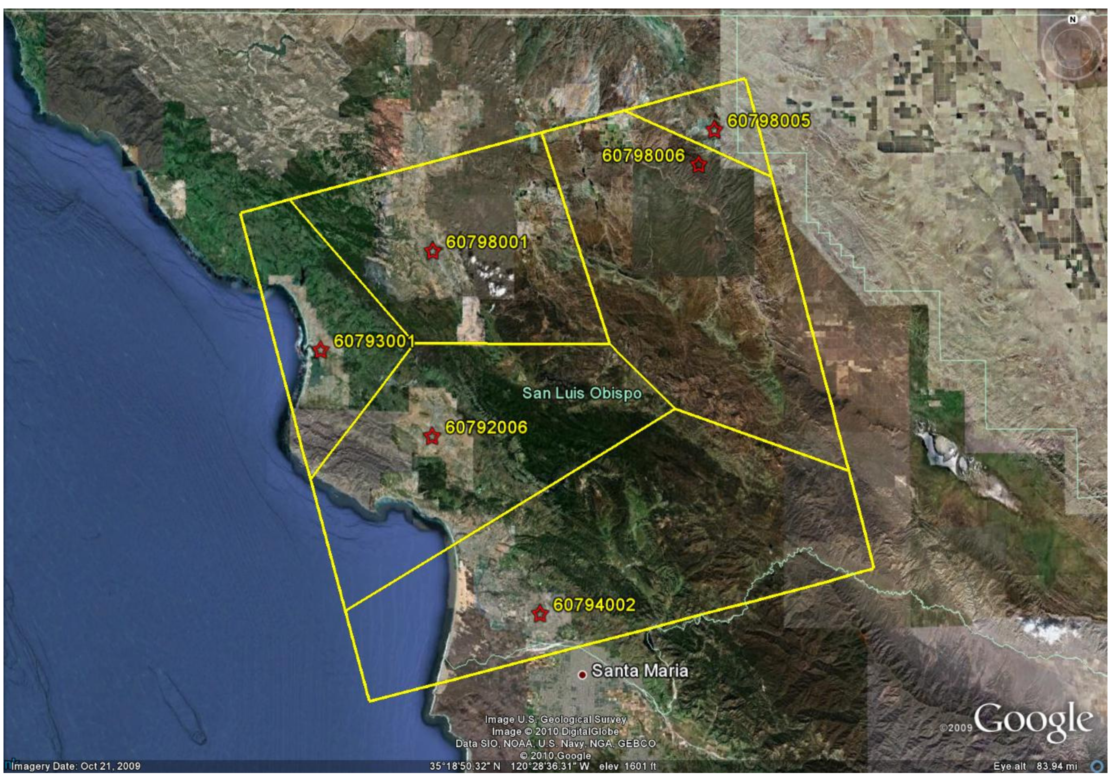

Figure 10: Area Served Analysis for Ozone

5.0 SITUATIONAL ANALYSIS

This section examines the network taking into account research, policy and resource needs.

5.1 Risk of Future NAAQS Exceedances

In San Luis Obispo County we are at risk for exceeding NAAQS standards for ozone in the eastern interior valleys and for PM2.5 on the Nipomo Mesa.

The eastern interior valleys are strongly influenced by their proximity to the San Joaquin Valley with its relatively high pollutant levels. Although the region is sparsely populated the District operates two monitoring stations to perform surveillance in the areas where people live and to document transport of pollutants from outside of the county. This is the only region of the county with ozone concentrations routinely high enough to violate federal standards.

On the Nipomo Mesa the state PM10 standard is exceeded frequently during wind events but the federal PM10 standard is exceeded only rarely. The Nipomo Mesa is downwind of a significant source of fine particulate in the Oceano Dunes State Vehicular Recreation Area (ODSVRA). The District is currently working with the California State Parks Department to find ways to mitigate emissions from their facility. In the meantime three monitoring locations at CDF, NRP and MESA2 perform surveillance of particulate emissions. No other area of the county is at risk for exceeding the NAAQS for airborne particulates.

5.2 Demographic Shifts

All of San Luis Obispo County is experiencing population growth. Most of the increase in population, however, has occurred within 25 miles of the coast with two areas; Paso Robles/Templeton and the Nipomo Mesa growing the most rapidly. Both of these fast-growing areas have an adequate complement of monitors for ozone, PM10 and PM2.5 - the pollutants of greatest concern.

5.3 Scientific Research and Public Health

The Atascadero monitoring station has historical importance as a research site. The station has hosted a variety of special instrumentation and has played and important role in epidemiological and other studies.

The particulate monitoring network on the Nipomo Mesa has been expanded in recent years to address the public health risk from particulate emissions upwind at the ODSVRA. The network may be modified to meet the needs of air quality surveillance as we move forward with mitigating impacts from the state park.

5.4 Other Circumstances

The San Luis Obispo and Paso Robles monitoring stations are operated by ARB. Although they are included in this assessment, they are not under the District's authority and may not be readily modified by the results of our analyses. The ARB is performing its own network assessment which will address the technical aspects related to these stations.

6.0 DISCUSSION AND CONCLUSIONS

6.1 Reduction of Measurements

The statistical analyses performed in section 4 revealed several instances of apparent measurement redundancy in the ambient air monitoring network. Each of these instances is discussed below:

In both the ozone and particulate networks, monitoring redundancies were identified in the Atascadero/Paso Robles and Morro Bay/NRP couplings by the Measured Concentration and Monitor Correlation analyses. This suggests that either of the stations in the couplings could be dropped and the data from the remaining station could be interpolated to represent that area.

In the case of Atascadero/Paso Robles the ozone and particulate monitors are both operated by different agencies, have long monitoring histories and are located in larger cities within the county. These factors and a small but notable difference in pollutant concentrations at the sites are considered by the SLOAPCD to outweigh budgetary considerations at this time.

In the case of Morro Bay/Nipomo coupling the Morro Bay monitor measures boundary conditions near the shore and most often represents conditions offshore while the NRP monitor measures background at a coastal interior site and has the highest design value in the coastal zone. For this reason they are both considered valuable and capable of generating useful information.

6.2 Addition of Measurements

The statistical and situational analyses performed in sections 4 & 5 did not turn up any instance where additional monitoring was indicated. The SLOAPCD ambient monitoring network is very comprehensive as it currently exists. Additional monitoring may become necessary in certain areas, such as the Nipomo Mesa, as the air quality situation changes over time. The District is prepared to address additional monitoring needs as they evolve.

6.3 Proposed Changes to the Monitoring Network

No changes to the SLOAPCD ambient air monitoring network are proposed at this time as a result of this network assessment.